

# WELCOME

## Safety

## Glazing

## 2018

## IRC & IBC

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### INSTRUCTOR:



Russell Thornburg  
507.413.2027  
[russell.thornburg1@gmail.com](mailto:russell.thornburg1@gmail.com)

#### Background:

Building Contractor  
Building Inspector Technician  
Field Inspector  
Plans Examiner  
Code Development Committee  
Code Trainer  
Code Consultant

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## Disclaimer

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**In Reference to all: Materials / Products / Illustrations / Pictures  
of this presentation**

## "Do not Assume:"

- ...that any picture in this presentation is in compliance of code, manufacturer's listing etc...
- ...that any product has been fully researched to the intent of the code
- ...that any product that can be sold / purchased meets any code requirements
- ...that any one product has been tested and meets the intent of any past/current adopted codes
- ...that any product has been properly installed unless you have done a complete research of that product through the manufacturer's installation instruction, approved acceptable tested listing, and have reviewed its current evaluation report requirements.

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## Safety Glazing



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It is impossible to Review Safety Glazing without the Code Books



[www.iccsafe.org](http://www.iccsafe.org)



[www.iccsafe.org](http://www.iccsafe.org)

## Resource Material



[www.iccsafe.org](http://www.iccsafe.org)



Americas Glass Association

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## Safety Glazing



### Introduction:

IBC & IRC code languages will be used along some industry vocabulary.

**Additional Material:** Incorporated in this compilation are references to the federally mandated requirements for safety glazing in all doors and shower assemblies established by:

Consumer Product Safety Commission on July 6, 1977 as Regulation 16 CFR Part 1201, 249pg.

### Scope:

This presentation is designed for use by glazing contractors, plan examiners, building inspectors, architects and code specifiers.

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## Safety Glazing



### 👉 Purpose:

This presentation is to consolidate all substantive references to glass, glazing and glazing products from INTERNATIONAL BUILDING CODE®. The IBC – Chapter 24 and IRC Section R308 is the primarily glazing code languages, but it does not contain all requirements for the application of safety glazing.

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## Code of Federal Regulations

Cite this Code: CFR

To cite the regulations in this volume use title, part and section number. Thus, 16 CFR 1.1 refers to title 1, part 1, section 1.

### Inserts - clips

Commission estimates that 73,000 injuries associated with architectural glazing materials in the architectural products within the scope of this standard were treated in hospital emergency rooms during 1975, and that about 2,400 of these injuries required the patients to be hospitalized. Extrapolating to total injuries in the United States the Commission further estimates that approximately 190,000 injuries were associated with architectural glazing products covered by this standard. Although injuries occur at any age, children aged 14 and under appear to be at particular risk of injury since as a

16 CFR Ch. II (1–1–12 Edition)

249pg

### PART 1201—SAFETY STANDARD FOR ARCHITECTURAL GLAZING MATERIALS

#### Subpart A—The Standard

Sec.  
1201.1 Scope, application and findings.  
1201.2 Definitions.  
1201.3 General requirements.  
1201.4 Test procedures.  
1201.5 Certification and labeling requirements.  
1201.6 Prohibited stockpiling.  
1201.7 Effective date.  
FIGURE 1 TO SUBPART A—GLASS IMPACT TEST STRUCTURE  
FIGURES 2 TO SUBPART A—TEST FRAME  
FIGURES 3 AND 4 TO SUBPART A—TEST SPECIMENS  
FIGURE 5 TO SUBPART A—IMPACTOR  
Subpart B (Reserved)  
Subpart C—Statements of Policy and Interpretation  
1201.40 Interpretation concerning bathtub and shower doors and enclosures.  
AUTHORITY: Secs. 2, 5, 7, 9, 14, 16, Pub. L. 92-573, 90 STAT. 3853-37; (16 U.S.C. 2063, 2065, 2066, 2068, 2069, 2063, 2069).  
SOURCE: 42 FR 1441, Jan. 6, 1977, unless otherwise noted.

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### Explanation

The Code of Federal Regulations is a codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government. The Code is divided into 50 titles which represent broad areas subject to Federal regulation. Each title is divided into chapters which usually bear the name of the issuing agency. Each chapter is further subdivided into parts covering specific regulatory areas.

Each volume of the Code is revised at least once each calendar year and issued on a quarterly basis approximately as follows:

Title 1 through Title 16.....as of January 1  
Title 17 through Title 27.....as of April 1  
Title 28 through Title 41.....as of July 1  
Title 42 through Title 50.....as of October 1

The appropriate revision date is printed on the cover of each volume.

#### LEGAL STATUS

The contents of the Federal Register are required to be judicially noticed (44 U.S.C. 1507). The Code of Federal Regulations is prima facie evidence of the text of the original documents (44 U.S.C. 1510).

#### HOW TO USE THE CODE OF FEDERAL REGULATIONS

The Code of Federal Regulations is kept up to date by the individual issues of the Federal Register. These two publications must be used together to determine the latest version of any given rule.

To determine whether a Code volume has been amended since its revision date (in this case, January 1, 2012), consult the "List of CFR Sections Affected (LSA)," which is issued monthly, and the "Cumulative List of Parts Affected," which appears in the Reader Aids section of the daily Federal Register. These two lists will identify the Federal Register page number of the latest amendment of any given rule.

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## Code of Federal Regulations

The safety requirements are designed to **reduce or eliminate unreasonable risks of death or serious injury to consumers** when glazing material is broken by human contact.

The standard applies to glazing materials and architectural products incorporating glazing materials that are produced or distributed for sale to or for the personal use, consumption or enjoyment of consumers in or around a permanent or temporary household or residence or in recreational, school, public, or other buildings or parts thereof. This part

1201 applies only to those glazing materials manufactured after the effective date of the standard; and to those architectural products identified in paragraph (a) of this section that are manufactured after the effective date of the standard.

16 CFR Ch. II (1–1–12 Edition)

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## Safety Glazing



### Goal & Objective:

It is important to remember the goal for safety glazing: “reduce serious injury from broken glass by accidental impact”.

The primary objective is to promote uniformity in application of safety glazing.

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## Safety Glazing - Prep



### Defining hazardous locations into their probability factor of accidental impact:

- ↳ **Continuously Hazardous Location** – would be the glass walls and doors of *racquetball and squash courts*. The probability factor of impact is 100%. The glass must be designed not to break upon impact.



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## Safety Glazing - Prep



### Defining hazardous locations into their probability factor of accidental impact:

- ↳ **Frequently Hazardous Locations** – would be glazing in *doors, sidelites and railings*. These locations are subject to frequent contact due to the need of using the glazing, such as, a door or railing. *Sidelites* are frequently contacted because they may be mistaken for an opening or because contact is difficult to avoid due to movement of people through or near doors. These location must be safety glazed.



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## Safety Glazing - Prep

### Defining hazardous locations into their probability factor of accidental impact:

- ↳ **Occasionally Hazardous Location** – would be those *other glazed openings* that might be mistaken for access, inability to recognized glazing or simply because the glazing is accessible to accidental contact. These openings shall be safety glazed or protected offered the use of guardrails.

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## Code Definitions – Safety Glazing Terms

### IRC 201.3 Terms defined in other codes.

- ...terms that are not defined in this code such terms shall have meanings ascribed to them as in other code publications of the ICC.

### IRC 201.4 Terms not defined.

- ...terms that are not defined through the methods authorized by this section, such terms shall have ordinarily accepted meanings such as the context implies.

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## Definitions – Safety Glazing Terms

### IBC 201.3 Terms defined in other codes.

- Where terms are not defined in this code and are defined in the IECC, IFGC, IFC, IMC or IPC, such terms shall have the meanings ascribed to them as in those codes.

### IBC 201.4 Terms not defined.

- Where terms are not defined through the methods authorized by this section, such terms shall have ordinarily accepted meanings such as the context implies.

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## Definitions – Safety Glazing Terms



### • Annealed Glass.

This is raw/float glass that after cooling from its molten state is cut into “stock sheets” for packing and shipping. Much of this production is used for glazing without further processing. **Safety Glazing** is produced by the further process of tempering and/or laminating.

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## Definitions – Safety Glazing Terms

### • Bug

The permanent identification placed on each lite of safety glass. The act of permanently marking glass by ceramic firing, sandblasting or acid etching is called “bugging.”

16 CFR 1201.2 (22) *Permanent label* means a label that will remain permanently legible and visible after installation of the glazing material and that would be

destroyed in attempts to remove it from the glazing material and includes (but is not limited to) sandblast, acid etch, hot-stamp, and destructible polyester labels.



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## Definitions – Safety Glazing Terms

### (7) Door

Means an assembly that is installed in an interior or exterior wall; that is movable in a sliding, pivoting, hinged, or revolving manner of movement; and that is used by consumers to produce or close off an opening for use as a means of human passage.

Doors designed for vehicular traffic do not have to be safety glazed but ...



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## Definitions – Safety Glazing Terms

### • **Glazing**

As a verb, this is the act of installing glass or plastic materials into windows and openings.

As a noun, this refers to the entire system of glass, plastic, and its framing members.



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## Definitions – Safety Glazing Terms

- Heat-strengthened glass is twice as strong as annealed glass of the same thickness, size and type. If broken, heat-strengthened glass will break into large shards similar to annealed glass. Because of this, the tendency for the glass to vacate the opening is reduced.
- Glass may not be cut after processing. It is used where additional strength is required; it has less distortion than tempered glass, and is resistant to thermal shock. H.S. Glass is not a safety glazing product.
- While improving the strength and resistance to thermal shock and stress, heat-strengthened glass does not meet safety glazing requirements as outlined by the American National Standards Institute (ANSI) Z97.1 or the federal safety standard Consumer Products Safety Commission (CPSC) 16 CFR 1201, and therefore should not be used in these situations.



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## Definitions – Safety Glazing Terms

### • **Laminated Glass**

This is the process of "sandwiching" polyvinyl butyral (PVB) with a lite of annealed, heat strengthened or tempered glass on either side. This is done under extreme pressure and renders the product into a single, three-ply product.

Laminated glass is a safety product that meets the CPSC Standard, 16 CFR 1201, Cat I and II.



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## Identifying Laminated Glass

Laminated glass can be identified by the reflection in the glass – if you hold your hand to it, you will see two reflections



Safety Glazing by Douglas Hansen

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## Definitions – Safety Glazing Terms

- **Lite.**

Lite is a pane (light) of glass.



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## Definitions – Safety Glazing Terms

- **Tempered Glass.**

This is a heating and cooling process to greater limits than H.S Glass that produces a product four times the strength of annealed glass. Tempered glass cannot be cut, drilled, ground, or polished treatment without fracture. Tempered glass has a characteristic bow or warp to the limitations set forth in ASTM Standard C-1048. Tempered glass is the most popular safety glass used that meets CPSC Standard, 16 CFR 1201, Cat II.



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## Verifying Tempered Glazing

- Inspectors are often baffled by glass that has a frame obscuring the label, or in the case of shower doors, a soap or hard-water residue obscuring the glass. It is possible to verify that tempered glass is present by using a pair of polarized light lenses.
- Normally, if you hold two such lenses over your flashlight, and rotate the lenses to where their polarities are at 90 degrees to each other, all light will be blocked. If you do this with a pane of tempered glass between them, distinctive black lines will appear as you rotate the lenses toward total blackness.



Safety Glazing by Douglas Hansen

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## Definitions – Safety Glazing Terms

- **Wire Glass.**

A single piece of annealed glass that contains wire embedded in the body of the glass.

Wire glass is not a safety glass and shall not be used in hazardous locations. (See fire glazing exception.)



16 CFR 1201.2 (34)

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## Identification IRC 308.1

☞ What information is required on the bug?

- ✓ Which manufacturer's provided the glazing and
- ✓ Type of glazing and
- ✓ Safety glazing standard with which it complies and
- ✓ Visible at final installation

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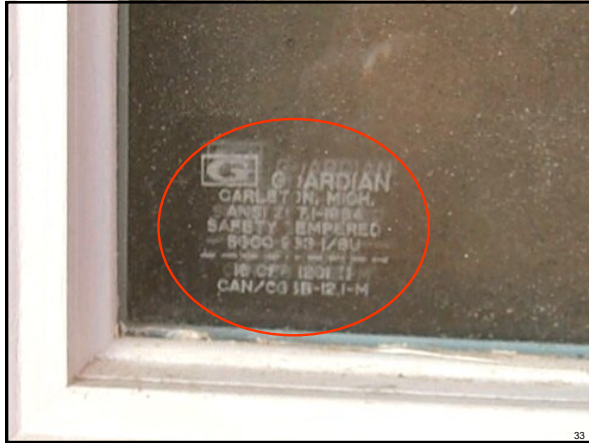
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## Identification IRC Section R308.1

- Safety glazing to be identified by one of the following methods:
  - Acid etched
  - Sandblasted
  - Ceramic-fired
  - Embossed mark
  - Type, which once applied cannot be removed without being destroyed
- For other than tempered glass, labels may be omitted where approved by the building official and a certificate, affidavit or other evidence is provided.

R308.1 & IRC 2406.3

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## Identification

COMPANY NAME OR IDENTIFICATION <sup>c</sup>	ABC Glass Co.	
INDICATES COMPLIANCE WITH STANDARD AND CATEGORY <sup>a</sup>	Tempered Safety Glass 16 CFR 1201 - II	TYPE OF SAFETY GLAZ
SGCC IDENTIFICATION NUMBER	ANSI Z97.1-1984 SGCC - 1234 1/4" - U	INDICATES COMPLIANCE WITH STANDARD
		NOMINAL THICKNESS / SIZE <sup>b</sup>

For SI: 1 inch = 25.4 mm, 1 square foot = 0.0929 m<sup>2</sup>.

a. "I" after "16 CFR 1201" indicates sizes 9 square feet and less are covered; "II" indicates all sizes are covered.  
 b. "U" indicates all sizes are covered; "L" indicates only sizes listed by the Safety Glazing Certification Council (SGCC) are covered.  
 c. Numbers or letters for date coding and plant identification may also be included.

EXAMPLE IDENTIFYING MARK

What is required on this label for IBC that is not required on IRC?

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## Conditional Exceptions



- Laminated glass,
- Tempered spandrel glass and
- Multi pane
  - 1 square foot Max
  - Min. 1 pane marked

IRC R308.1 & R308.1.1 & IBC 2406.3.1

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## Identification of Safety Glazing

Each lite of safety glass whether tempered or laminated glass, shall be permanently designated (labeled) or bugged by the manufacture.

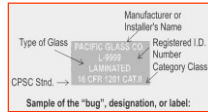
There are only two types of safety glass, tempered and laminated.

Tempered glass shall be bugged by the manufacturer's only.

Laminated glass shall be bugged by

either the manufacture or the installer.

Since the manufacture's bug may be cut from the original lite of laminated glass, the installer shall apply it's bug.



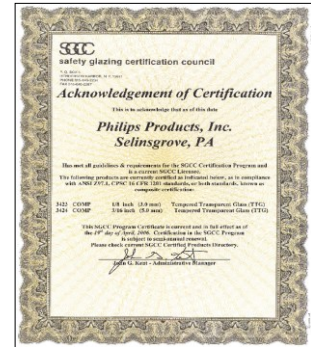
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**SAMPLE  
DOCUMENT**

## Affidavit

### Exception 1.

• For other than tempered glass, labels may be omitted where approved by the building official and a certificate, affidavit or other evidence is provided.



IRC R308.1 except 1, IRC 2406.3 except 1

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## Glazing - Bug IRC section R308

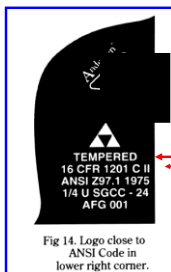


Fig 14. Logo close to ANSI Code in lower right corner.

### Exceptions:

1. For other than tempered glass, manufacturer's designations are not required provided the building official approves the use of a certificate, affidavit or other evidence confirming compliance with this code.

**R308.3 Human impact loads.** Individual glazed areas, including glass mirrors in hazardous locations such as those indicated as defined in Section R308.4, shall pass the test requirements of CPSC 16 CFR, Part 1201. Glazing shall comply with CPSC 16 CFR, Part 1201 criteria for Category I or Category II as indicated in Table R308.3.

IRC 308.1 &amp; IRC 2406.3

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## Glazing

- Louvered windows or jalousies of regular, float, wired or patterned glass specifically regulated:

- Minimum thickness of 3/16 inch
- Maximum length of 48 inches
- Smooth glass edges where exposed
- No wire exposed on longitudinal edges of wired glass jalousies



As long as the glass meets these requirements

IRC R308.2 &amp; IRC 2403.5 &amp; IRC 2406.1.4

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## Solid Backing

- Mirrors and other glass panels mounted or hung on a surface that provides a continuous backing support.



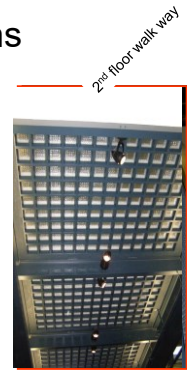
IRC R308.3 except 2  
IBC 2406.1 except

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## Exceptions

Glass block panels complying with Section R607.

- Hollow glass units shall...minimum average glass face thickness of 3/16 inch
- shall be standard or thin units
  - standard...thickness shall be at least 3 7/8"
  - thickness of thin units shall be at least 3 1/8 inches for hollow units and at least 3 inches for solid units.



R308.3 Except 3

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## Human impact loads R308.3

- Where glazing occurs in fire doors and fire windows, it must now comply with the test requirements of CPSC 16 CFR, Part 1201,
- as the use of polished wired glass tested in accordance with ANSI Z97.1 is no longer permitted.



[Understanding ANSI Z97.1 Testing](#)

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## Brief History of Wired Glass



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- Late 70's the federal safety-glazing standard 16 CFR 1201 established.
- Wired glass was only fire-rated product available.
- CPSC temporarily exempted wired glass in fire assemblies. Intended to end after 2 ½ years.
- Exemption extended indefinitely after industry files lawsuit challenging termination date.
- Result is wired glass in fire assemblies subject to lower 100-ft.lb impact standard.
- CPSC rejects standard as inadequate to protect anyone other than children under 5 years old.

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## End Results

- The result is that when wired glass breaks, the exposed wires act like a spider web to trap the victim and increase injuries when he/she attempts to withdraw from the opening.



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## Glazing Test Standards

### R308.1.1 Identification of Glazing and Human Impact Loads

- CPSC 16 CFR 1201 regulated by the federal standard [Table R308.3.1\(1\)](#) or Table 2406.2(1)
- ANSI Z97.1 as an alternative test procedure to for safety glazing products not regulated by the federal standard. [Table R308.3.1\(2\)](#)
- [www.ansi.org](https://www.ansi.org)

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## Principal Differences

### CPSC 16 CFR 1201

Is a federal standard that mandates where and when safety glazing materials must be used.

Preempts any non-identical state or local standard.

### ANSI Z97.1-204

Is a voluntary safety performance specification and test method.

Does not attempt to declare when and where safety glazing materials must be used.

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## CPSC 16 CFR 1201

Consumer Product Safety Commission  
Title 16 Commercial Practices  
Code of Federal Regulations  
Part 1201

Safety Standard for  
Architectural Glazing Materials  
Category I & Category II

16 CFR 1201.4

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## Impact Categories or Levels

**Category I**  
**Class B**  
18-inch drop height

150 foot-pound impact



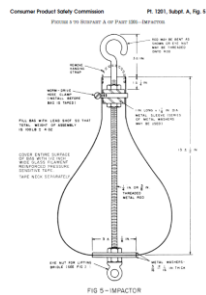
**Category II**  
**Class A**  
48-inch drop height  
400 foot-pound impact



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## One Impact test

(2) **Impactor.** (i) The impactor shall be a leather punching bag as shown in figure 5 on this section. The bag shall be filled with No. 7 1/2 chilled lead shot to a total weight of completed assembly as shown in figure 5, of 100 pounds  $\pm 4$  ounces (45.36  $\pm 0.11$  kilograms). The rubber bladder shall be left in place and filled through a hole cut into the upper part. After filling the rubber bladder, the top should be either twisted around the threaded metal rod below the metal sleeve or pulled over the metal sleeve and tied with a cord or leather thong.



16 CFR 1201.4

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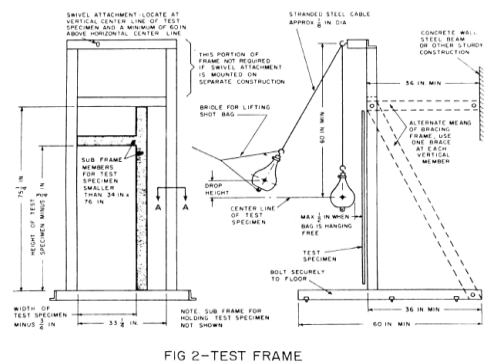


FIG 2-TEST FRAME

Consumer Product Safety Commission

FIG 2-TEST FRAME

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## Category I & Category II

Table R308.3.1(1)  
Minimum Category Classification of Glazing Using CPSC 16 CFR 1201

Exposed Surface area of One Side of One Lite	Glazing in Storm or Combination Doors (Category Class)	Glazing in Doors (Category Class)	Glazed Panels Regulated by Section R308.4.3 (Category Class) <b>Windows</b>	Glazed Panels Regulated by Section R308.4.2 (Category Class) <b>Adjacent to Doors</b>	Glazing in Doors and Enclosures Regulated by Section R308.4.5 (Category Class) <b>Adjacent to Wet Areas</b>	Sliding Glass Doors Patio Type (Category Class)
9 sq ft or less	I	I	NR	I	II	II
More than 9 sq ft	II	II	II	II	II	II

### R308.3.1 Impact test

Where required by other sections of the code, glazing shall be tested in accordance with CPSC 16 CFR 1201. **Glazing shall comply with the test criteria for Category II unless otherwise** indicated in Table R308.3.1(1).

R308.3.1 Impact test & Table IBC 2406.2(1)

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## Category I products

- Storm doors or combination doors that contain no single piece of glazing material greater than 9 square feet in surface area.
- Doors that contain no single piece of glazing material greater than 9 square feet in surface area.
- Glazing adjacent doors fixed or operable panel with no single piece of glazing material greater than 9 square feet in surface area.

R308.3.1 Impact test & Table IBC 2406.2(1)

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## Category II products

- Storm doors or combination doors > 9 sq. ft. in surface area.
- Doors that contain > 9 sq. ft. in surface area.
- Glazed Panels > 9 sq. ft./conditions
- Glazing adjacent to doors individual fixed or operable < 60" above the floor or walking surface
- Glazing in Doors and Enclosures

R308.3.1 Impact test & Table IBC 2406.1

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## Impact test – Except.

### R308.3.1 Impact Test

- Exception: Glazing not in doors or enclosures for hot tubs, whirlpools, saunas, steam rooms, bathtubs and showers shall be permitted to be tested in accordance with ANSI Z97.1. Glazing shall comply with the test criteria for Class A unless otherwise indicated in Table R308.3.1(2).**

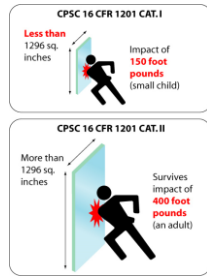
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## What is Consumer Product Safety Commission 16 CFR 1201?

A federal safety glazing minimum standard established in 1977 to protect people from injuries due to accidental impact with glazing.

Two categories were established:

- Cat. I = for small glazing areas (less than 1296 square inches) to survive impact of 150 foot pounds - a small child.
- Cat. II = for large glazing areas (more than 1296 square inches.) to survive an impact of 400 foot pounds - an adult.



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## Not listed in the Table

- R308.4.4 Glazing in guards and railings.  
(Table R301.5 ft. h. Glazing used in handrail assemblies and guards shall be designed with a safety factor of 4).

Guards and handrails <sup>a</sup>	200 <sup>h</sup>
Guardrail in-fill components <sup>d</sup>	50 <sup>h</sup>

- R308.4.6 Glazing adjacent stairs & ramps.
- R308.4.7 Glazing adjacent to the bottom stair landing.
- R308.5 Site built windows – 2404 IBC.

**R308.3.1 Impact test.** Where required by other sections ... **Glazing shall comply with the test criteria for Category II unless otherwise**

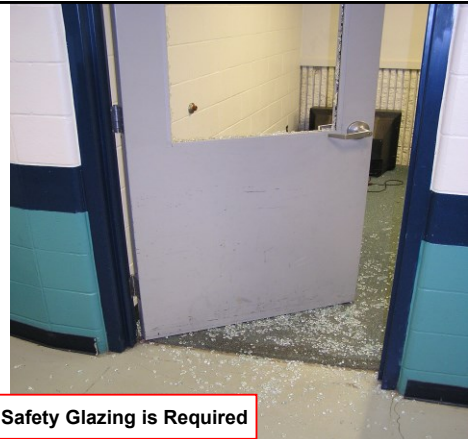
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## Why Safety Glazing is Important



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## Why Safety Glazing is Required



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Plate Glass

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### IRC section R308.4 & IBC 2406.3 Glazing Review Steps

1. Check for safety glazing labeling requirements.
2. Check louvered window and jalousies.
3. Check hazardous locations for safety glazing requirements taking into consideration the structure's both interior and exterior.

What is the difference between tempered and safety glazing?

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## Glazing in Hazardous Locations R308.4



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## Hazardous Locations

- Glazing in swinging doors.

Cat. I or Cat. II



R308.4(1), Table R308.3.1(1) & 2406.4.1, Table 2406.2(1)

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## Hazardous Locations

- Storm doors.

Cat. I or Cat. II



R308.4 (1) & 2406.4.1

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## Hazardous Locations

- Glazing in all swinging doors.

Cat. I or Cat. II



R308.4 (1) & 2406.4.1

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## Hazardous Locations



R308.4 (1) &amp; 2406.4.1

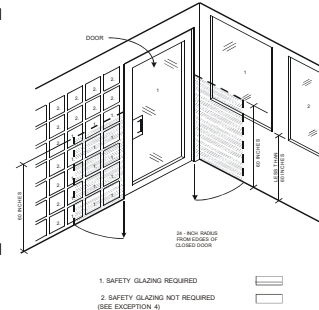
- Glazing in all fixed and operable panels of swinging, sliding and bifold doors.

Cat. I or Cat. II

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## Hazardous Locations

- Glazing in an individual fixed or operable panel adjacent to a door where the nearest vertical edge of the glazing is within a 24" arc of either vertical edge of the door in a closed position and where the bottom exposed edge of the glazing is < 60" above the walking surface shall be considered a hazardous location.

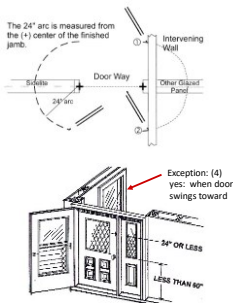


Safety Glazing in Close Proximity to Doors

IBC 2406.4.2

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## Hazardous Locations



IBC 2406.4.2

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- Fixed or operable panels within 24" arc of vertical edge of door in a closed position.

## Hazardous Locations

### Glazing adjacent to doors.

Glazing in an individual fixed or operable panel adjacent to a door shall be considered to be a hazardous location where the bottom exposed edge of the glazing is < 60" above the floor or walking surface and it meets either of the following conditions:

- Where the glazing is within 24" of either side of the door in the plane of the door in a closed position.
- Where the glazing is on a wall < 180 degrees from the plane of the door in a closed position and within 24" of the hinge side of an in-swinging door.

R308.4.2

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## Glazing Adjacent to Doors

1. Where the glazing is within 24" of either side of the door in the plane of the door in a closed position



R308.4.2

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## Hazardous Locations

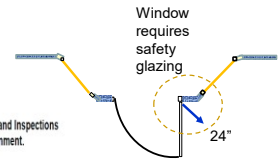
Public Comment 1:

Jonathan Siu, representing City of Seattle Department of Construction and Inspections (Jon.Siu@seattle.gov) requests Approve as Modified by this Public Comment.

Modify as follows:

**R308.4.2 Glazing adjacent to doors.** Glazing in an individual fixed or operable panel adjacent to a door shall be considered to be a hazardous location where the bottom exposed edge of the glazing is less than 60 inches (1524 mm) above the floor or walking surface and it meets either of the following conditions:

1. Where the glazing is within 24 inches (610 mm) of either side of the door in the plane of the door in a closed position.
2. Where the glazing is on a wall not in less than 180 degrees from the plane of the door in a closed position and within 24 inches (610 mm) of the hinge side of an in-swinging door.



Final Action Results  
RB79-16 AMPC1

75

Safety glazing  
Required.

Cat. I or Cat. II

R308.4.2

76



**Exception: 2** When there is an intervening wall or other permanent barrier between the door and the glazing.

IRC R308.4.2 &amp; IBC 2406.4.2

77

## Hazardous Locations

Exception 3: Where access through the door is to a closet or storage area 3' or less in depth. Glazing in this application shall comply with Section R308.4.3



**Hinged Side - Yes**



**Latch side - No**

IRC section R308.4.2 except 3

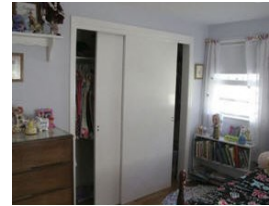
78

## Hazardous Locations

**Exception 3:** Where access through the door is to a closet or storage area 3' or less in depth. Glazing in this application shall comply with [Section R308.4.3](#).



**If closet is >3" deep, then window requires tempered glazing**



**Does not apply to sliding doors**

IRC section R308.4.2 except 3

79

Exception:

Where access through the door is to a closet or storage area 3' or less in depth. Glazing in this application shall comply with Section R308.4.3



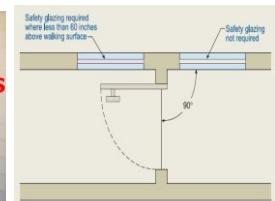
IRC section R308.4.2 except 3

80

## Hazardous Locations

Exception: 4

**Exception 4**  
Glazing in walls on the latch side of and perpendicular to the plane of the door in a closed position in one- and two-family dwellings or within dwelling units in Group R-2.



IBC: except (4)  
One and Two Family  
& R-2

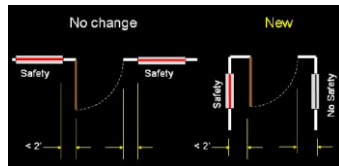
IBC 2406.4.2 except 4

81

## Hazardous Locations

Exception: 4

Glazing in walls on the latch side of and perpendicular to the plane of the door in a closed position in one- and two-family dwellings or within dwelling units in Group R-2.



IBC 2406.4.2 except 4

82

## Hazardous Locations

Section: R308.4.1 (New)

Proponent: Lee Kranz, City of Bellevue, WA, representing Washington Association of Building Officials Technical Code Development Committee (lkranz@bellevuewa.gov)

Add new text as follows:

**R308.4.1 Structural glass baluster panels.** Guards with structural glass baluster panels shall be installed with an attached top rail or handrail. The top rail or handrail shall be supported by a minimum of three glass baluster panels, or shall be otherwise supported to remain in place should one glass baluster panel fail.

**Exception:** An attached top rail or handrail is not required where the glass baluster panels are laminated glass with two or more glass plies of equal thickness and of the same glass type.

**Reason:** This proposal will clarify and align the IRC and IBC requirements for glass panels that are used as a structural component in a guard. Imperfections in glass can cause it to fail at loads that are well below its nominal resistance value. We believe the intent of the IBC requirements is to have something (a top rail or a handrail at stairs) to provide some additional fall protection for a person leaning on the guard, should a glass panel fail. Having a handrail attached to at least 3 panels also provides some backup support if a panel fails while someone is grabbing the handrail to prevent a fall. However, there is an exception that allows glass-only guards (without an attached top rail or handrail) if the balusters are laminated glass. The laminated glass provides some backup against total panel failure, but note that the entire glass baluster still has to be designed to be able to support the full loads for guards, as specified in Table R301.5, including using a factor of safety of 4 found in footnote "f".

We believe the IRC should also have these critical safety requirements, which it currently does not. The proposed code text is consistent with, but not identical to the IBC text (Section 2407.1.2). However, we believe this more clearly states the requirements, and have submitted a parallel amendment for the IRC.

**Cost Impact:** Will not increase the cost of construction

This change creates consistency with the IBC for glass guards only and allows for more safety and flexibility in design. There should be no increase in the cost.

<https://www.youtube.com/watch?v=BS-Qt5dR4dU>

83

**Table R301.5**  
**Minimum Uniformly Distributed Live Loads (lbs per Sq Ft)**

Guards and handrails <sup>d</sup>	200 <sup>h</sup>
Guard in-fill components <sup>f</sup>	50 <sup>h</sup>

- f. Guard in-fill components (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 lbs. on an area equal to 1 sq. ft. This load need not be assumed to act concurrently with any other live load requirement.
- h. Glazing used in handrail assemblies and guards shall be designed with a safety factor of 4. The safety factor shall be applied to each of the concentrated loads applied to the top of the rail, and to the load on the in-fill components...

- Interpretation: Handrails and guards.** Handrail assemblies and guards shall be designed to resist a load of 50 lbs. plf applied in any direction at the top and to transfer this load through the supports to the structure.

### Opinion

This states that the load must be met by the top of the guard 36". Glass balusters will not be able to meet the 800 lbs. (4 X 200 lbs.) concentrated load without an attached guard rail. And in the event of one panel's failure, a railing must remain at the top of the guard that meets the load requirement. An attached handrail will not meet this requirement.

84

## Hazardous Locations



This is a guard application with no top rail and an attached handrail. Handrail does not protect glass edging of impact. It has been included in an attempt to meet code by including an attached "handrail" in lieu of an attached "guard."

**Opinion**  
This problem begins with the interpretation of the phrase: **glass balusters shall not be installed without an attached handrail or guard.** Many installers, designers and inspectors are taking this sentence to indicate that as long as a handrail is in place, the code has been met.

85

## Hazardous Locations

Exception:

4. Glazing that is adjacent to the fixed panel of patio doors.



ICC Interpretation

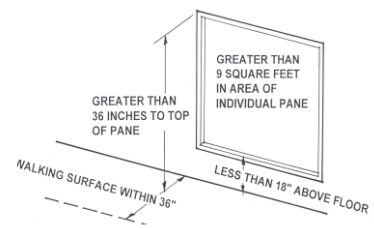
R308.4.2

86

## Hazardous Locations

3. Glazing in an individual fixed or operable panel that meets all of the following conditions:

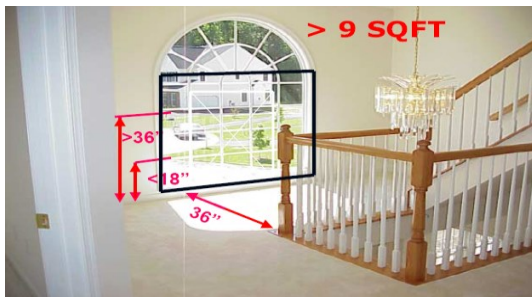
1. Exposed area of an individual pane larger than 9 square feet
2. Bottom edge less than 18" above the floor.
3. Top edge more than 36" above the floor.
4. One or more walking surfaces within 36" measured horizontally in a straight line, of the glazing.



IRC R308.4.3  
IBC 2406.4.3

87

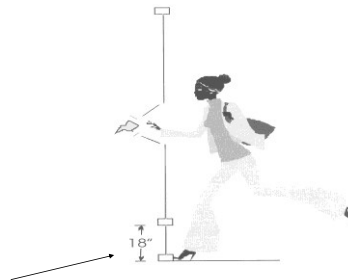
## Hazardous Locations



R308.4.3 & 2404.3

88

## Why 18 Inches

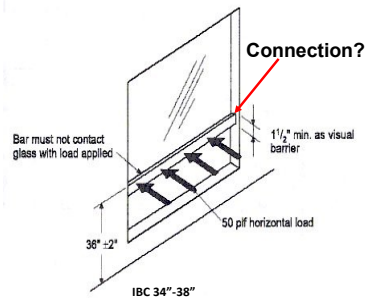


89

## Hazardous Locations

IRC

- Protected by horizontal bar installed on accessible side
- Bar height to be minimum of 1 1/2"
  - Bar to withstand minimum horizontal load of 50 plf without contacting glass
  - Bar to be located 34 – 38 inches above floor (plus or minus 2")



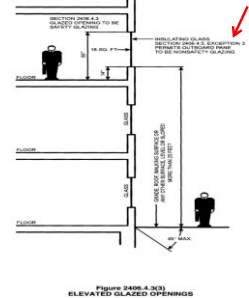
IRC R308.4.3, Except 2  
IBC 2406.4.3, Except, 2

90

## Hazardous Locations

Exception:

3. Outboard panes in insulating glass units **and** other multiple glazed panels when the bottom edge of the glass is 25' **or** more above grade, a roof, walking surfaces **or** other horizontal [within 45°] of horizontal] surface adjacent to the glass exterior.



R308.1 ...each pane of glazing installed in hazardous locations...  
2406.4.3 Glazing in windows

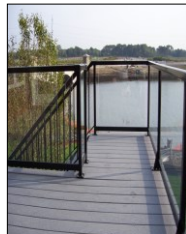
91

## Hazardous Locations

All glazing in railings regardless of an area or height above a walking surface. Included are structural baluster panels and nonstructural infill panels.

IRC TABLE R301.5  
Guardrails in-fill components<sup>d</sup> 50<sup>h</sup> (in pound per square foot)

- f. Guard in-fill components (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds on an area equal to 1 square foot.
- i. Glazing used in handrail assemblies and guards shall be **designed with a safety factor of 4**. The safety factor shall be applied to each of the concentrated loads applied ...to the load on the in-fill components.



IRC R308.4.4  
IBC 2406.4.4

Table R301.5

92

Table R301.5 (h) Glazing used in handrail assemblies and guards shall be designed with a safety factor of 4. The safety factor shall be applied to each of the concentrated loads applied to the top of the rail, and to the load on the in-fill components. These loads shall be determined independent of one another, and loads are assumed not to occur with any other live load.



93

## Hazardous Locations

### Glazing and wet surfaces

- Glazing in walls,
- Enclosures or fences containing or **adjacent to** hot tubs, spas, whirlpools, saunas, steam rooms, bathtubs, showers and indoor or outdoor swimming pools
- Where the bottom exposed edge of the glazing is < 60" measured vertically above any standing or walking surface shall be considered a hazardous location
- Applies to single glazing & **all panes in multiple glazing.**



R308.4.5 &amp; 2406.5

94

**R308.4.5** Glazing in walls, enclosures or fences containing or **adjacent to** hot tubs, spas, whirlpools, saunas, steam rooms, bathtubs, showers and indoor or outdoor swimming pools where the bottom exposed edge of the glazing is < 60" measured vertically above any standing or walking surface shall be considered to be a hazardous location. This shall apply to single glazing and each pane in multiple glazing.

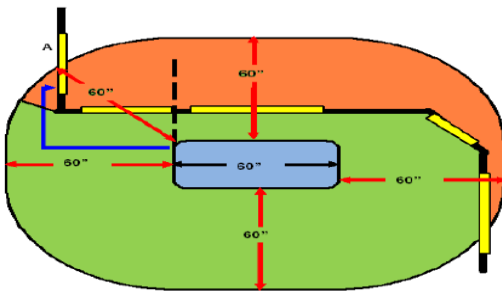
**Exception:** Glazing that is > 60", **measured horizontally, from the water's edge** of a bathtub, hot tub, spa, whirlpool or swimming pool or from the edge of a shower, sauna or steam room.



2406.4.5

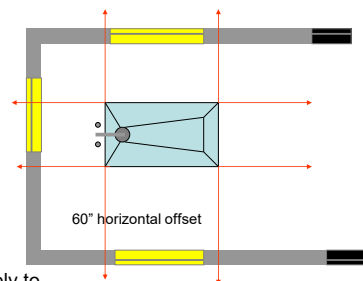
237-725 95

## Water Edge



96

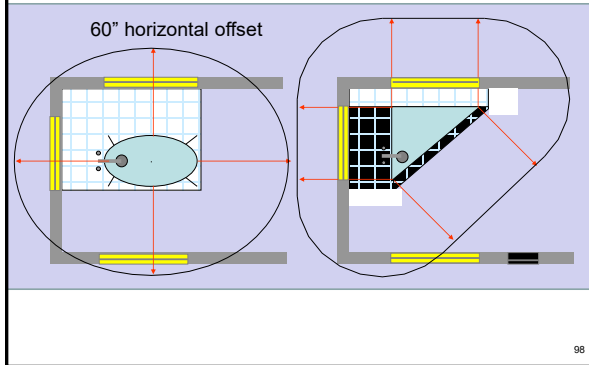
## R308.4.5: Safety Glazing



**\*\*Does apply to shower compartments**

97

## R308.4.5: Safety Glazing



## R308.4.5: Safety Glazing

Safety glazing:

required within 60" vertically of  
the walkway or standing surface

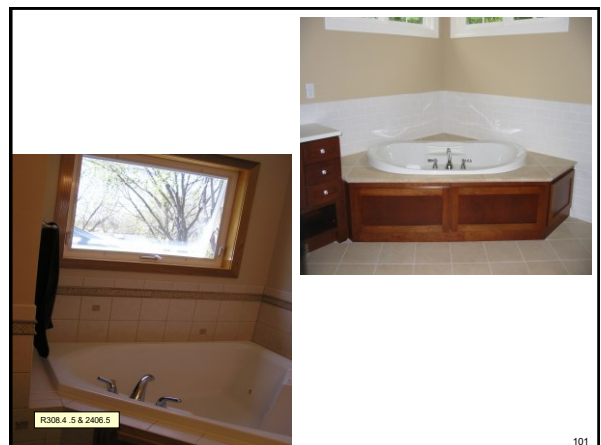
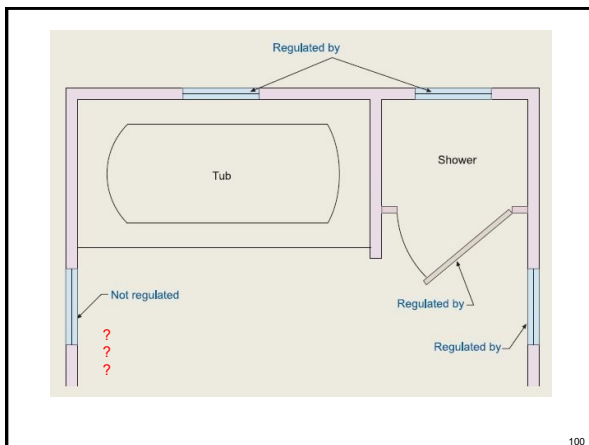
Cat. I or Cat. II



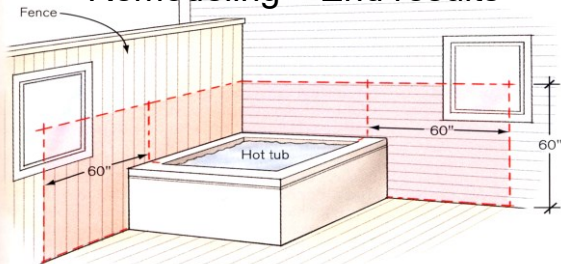
Safety glazing:

**Exception:** Glazing that is > 60",  
**measured horizontally, from the**  
**water's edge** of a bathtub, hot tub, spa,  
whirlpool or swimming pool or from the  
edge of a shower, sauna or steam room.

99



## Remodeling – End results



**R308.4.5 Glazing and wet surfaces.** Glazing in walls, enclosures or fences containing or adjacent to hot tubs, spas, whirlpools, saunas, steam rooms, bathtubs, showers and indoor or outdoor swimming pools where the bottom exposed edge of the glazing is < 60" measured vertically above any standing or walking surface shall be considered to be a hazardous location. This shall apply to single glazing and each pane in multiple glazing.

**Exception:** Glazing that is > 60", **measured horizontally, from the water's edge** of a bathtub, hot tub, spa, whirlpool or swimming pool or from the edge of a shower, sauna or steam room.

R308.4.5 & 2406.4.5

## Hazardous Location



**Exception:** Glazing that is > 60", **measured horizontally, from the water's edge** of a bathtub, hot tub, spa, whirlpool or swimming pool or from the edge of a shower, sauna or steam room.

R308.4.5

103

## Hazardous Locations

- **Glazing in walls, enclosures or fences containing or facing** hot tubs, spas, whirlpools, saunas, steam rooms, bathtubs, showers and **indoor or outdoor swimming pools** where the bottom exposed edge of the glazing is < 60" measured vertically above any standing or walking surface shall be considered a hazardous location. This shall apply to single glazing and all panes in multiple glazing.

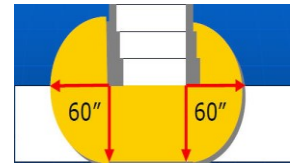


IRC R308.4.5  
IBC 2604.4.5

104

## Glazing Adjacent to the Bottom Stair Landing

- Glazing adjacent to the bottom stair landing is now defined as the area in front of the plane of the bottom tread



### R308.4.7 Glazing adjacent to the bottom stair landing.

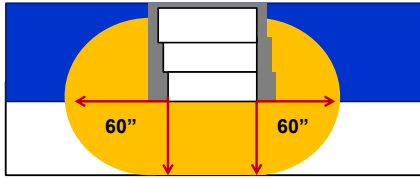
Glazing adjacent to the landing at the bottom of a stairway where the glazing is less than 36 inches (914 mm) above the landing and within ~~60 inches~~ **a 60-inch** (1524 mm) ~~horizontally~~ **horizontal arc less than 180 degrees from** the bottom tread ~~nosing~~ shall be considered **to be** a hazardous location.

R308.4.7

105

## Glazing Adjacent to the Bottom Stair Landing

Glazing adjacent to the landing at the bottom of a stairway where the glazing is  $< 60''$  above the landing and within a  $60''$  horizontal arc that is  $< 180$  degrees from the bottom tread nosing shall be considered a hazardous location.



IBC 2406.4.7

106

## Hazardous Locations

Glazing adjacent stairs and ramps.

- Glazing where the bottom exposed edge of the glazing is  $< 36''$  above the plane of the adjacent walking surface of stairways, landings between flights of stairs & ramps are considered in a hazardous location.



IRC 308.4.6

107

## Hazardous Locations

Glazing adjacent stairs and ramps.

- Glazing where the bottom exposed edge of the glazing is  $< 36''$  above the plane of the adjacent walking surface of stairways, landings between flights of stairs & ramps are considered in a hazardous location.



108

## Hazardous Glazing Locations



### R308.4.6 Glazing adjacent stairs and ramps.

Glazing where the bottom exposed edge of the glazing is  $< 36''$  above the plane of the adjacent walking surface of stairways, landings between flights of stairs & ramps are considered in a hazardous location.

109



#### Glazing adjacent to stairs and ramps.

Glazing where the bottom exposed edge of the glazing is  $< 60"$  above the plane of the adjacent walking surface of stairways, landings between flights of stairs, and ramps are considered a hazardous location.

2406.4.6

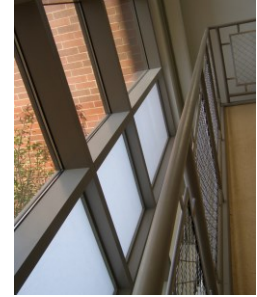
110

## Hazardous Locations

Glazing adjacent to stairs and ramps

#### Exceptions:

1. The side of a stairway, landing or ramp that has a guard complying with the provisions of Sections 1013 and 1607.8, and the plane of the glass is  $> 18"$  from the railing.
2. Glazing  $\geq 36"$  measured horizontally from the walking surface.



2406.4.6

111

## Hazardous Locations

#### • Exceptions:

1. .... and the plane of the glass is greater than 18 inches (457 mm) from the railing.



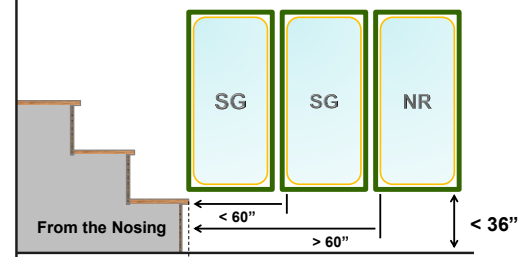
2406.4.6

112

## Hazardous Locations

R308.4.7 Glazing adjacent to the bottom stair landing

- Glazing adjacent to the landing at the bottom of a stairway where the glazing is  $< 36"$  above the landing and within  $60"$  horizontally of the bottom tread shall be considered a hazardous location.

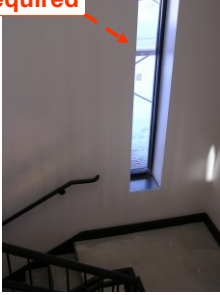


113



## Exceptions:

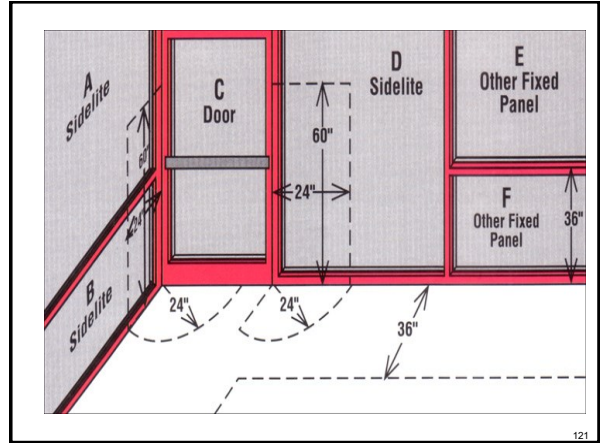
**Required**



IRC R308.4, 1 Exception 1  
IBC 2406.4.1 Exception 1

120

- ✎ Exception: The following products, materials and uses are exempt from the above hazardous locations:
- ✎ 1. Openings in doors through which a 3-inch sphere is unable to pass.



121

## Exceptions

- ✎ Exception: The following products, materials and uses are exempt from the above hazardous locations:

- 2. Decorative glass in Items 1, 2 or 3



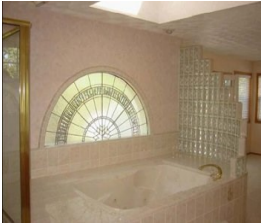
DECORATIVE GLASS  
IRC R308.4, (1, 2, 3)  
IBC 2406.4, (1, 2, 3)

124



123

## Leaded Glass



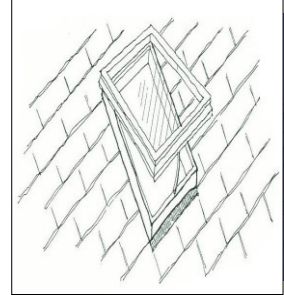
- In this example, the shower enclosure on the left/back contained tempered safety glass, and the glass blocks at the end of the tub are addressed.

Cat. I or Cat. II

125

## Safety Glazing Requirements

- R308.5 Site built windows.
- Site built windows shall comply with Section 2404 of the IBC.



126

## Skylights and sloped glazing

☞ ...shall comply with the following sections.

### Definitions:

#### R308.6.1 SKYLIGHTS AND SLOPED GLAZING.

- ☞ Glass or other transparent or translucent glazing material installed at a slope of 15 degrees or more from vertical.
- ☞ Glazing materials in skylights, unit skylights, tubular daylighting devices and glazing materials in solariums, sunrooms, roofs and sloped walls are included in this definition.

127

## Unit Skylight

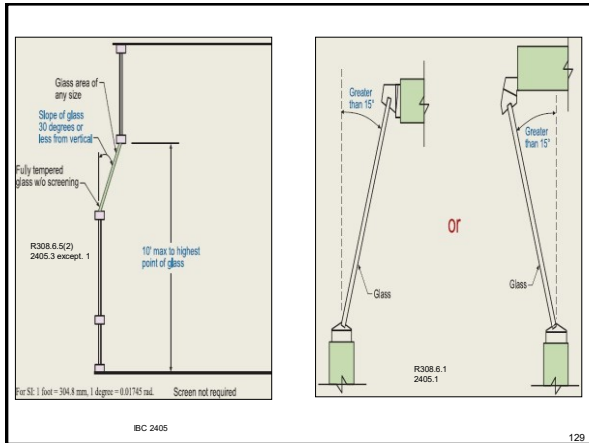
### Definitions:

- ☞ A factory assembled, glazed fenestration unit, containing one panel of glazing material, that allows for natural day lighting through an opening in the roof assembly while preserving the weather-resistant barrier of the roof



IRC R308.6.1

128



## Permitted materials

The following types of glazing may be used:

1. Laminated glass.
2. Fully tempered glass.
3. Heat-strengthened glass.
4. Wired glass.
5. Approved rigid plastics.

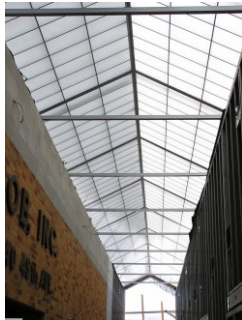


IRC R308.6.2

130

## 2405 Sloped Glazing and Skylights

- Applies to glazing installed at a slope more than 15 degrees from the vertical plane.
- Screening required capable of supporting twice the weight of the glazing. Noncombustible material. Firmly fastened to framing members.
- Note Exceptions.



IRC R 308.6.7

131

## R308.6 Skylight Glass Retention Screens

- New terminology clarifies the broken glass retention screen requirements.
- Approved laminated glass has no limitation size or heights.
- Laminated glass meeting specs does not require a retention screen.

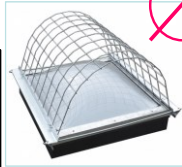


132

## R308.6 Skylight Glass Retention Screens



...be installed within 4" of the glass  
and  
Screen Opening  
Max. 1" x 1"



2405.3 Screening

133

## SCREENS NOT REQUIRED

- Skylights are not a "location subject to human impact" but precautions must be taken to assure occupant safety if the glass breaks. Glass in skylights or sloped glazing (more than 15 degrees off vertical) must be wired, plastic, laminated, heat-strengthened, or fully tempered.
- Screens are required below heat-strengthened or tempered glass panes, except for tempered glass less than 16 square feet and the highest point not more than 12 feet above a walking surface, or 10 feet if the glass is sloped 30 degrees or less from vertical

R308.6.5

134

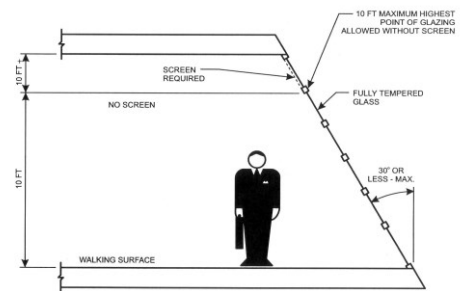


Laminated glass and plastic materials described in Items 1 and 2 shall not require the screening or height restrictions provided in [Section 2405.3](#).  
**2406.1.2 Plastic glazing.**  
Plastic glazing shall meet the weathering requirements of [ANSI Z97.1](#).

2405.2 Allowable glazing materials and limitations

135

## Slope Roof



FULLY TEMPERED GLAZING—30° MAXIMUM SLOPE

136



137

## Safety Glaze



### R308.6.6 Glass in greenhouses.

- Any glazing material is permitted to be installed without screening in the sloped areas of greenhouses, provided the greenhouse height at the ridge does not exceed 20 feet above grade.

138

## Testing and Labeling

- Unit skylights shall be tested by an approved independent laboratory, and bear a label identifying manufacturer, performance grade rating and approved inspection agency to indicate compliance with the requirements of AAMA/WDMA/CSA 101/I.S.2/A440.

IRC R308.6.9

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## 2406.4 Hazardous Locations

TABLE 2406.2(1)  
MINIMUM CATEGORY CLASSIFICATION OF GLAZING USING CPSC 16 CFR 1201

EXPOSED SURFACE AREA OF ONE SIDE OF ONE LITE	GLAZING IN STORM OR COMBUSTION DOORS (Category class)	GLAZING IN DOORS (Category class)	GLAZED PANELS REGULATED BY ITEM 7 OF SECTION 2406.4 (Category class)	GLAZED PANELS REGULATED BY ITEM 8 OF SECTION 2406.4 (Category class)	DOORS AND ENCLOSURES REGULATED BY ITEM 9 OF SECTION 2406.4 (Category class)	SLIDING GLASS DOORS PATIO TYPE (Category class)
9 square feet or less	I	I	No requirement	I	II	II
More than 9 square feet	II	II	II	II	II	II

For SI: 1 square foot = 0.0929 m<sup>2</sup>

TABLE 2406.2(2)  
MINIMUM CATEGORY CLASSIFICATION OF GLAZING USING ANSI Z97.1

EXPOSED SURFACE AREA OF ONE SIDE OF ONE LITE	GLAZED PANELS REGULATED BY ITEM 7 OF SECTION 2406.4 (Category class)	GLAZED PANELS REGULATED BY ITEM 8 OF SECTION 2406.4 (Category class)	DOORS AND ENCLOSURES REGULATED BY ITEM 9 OF SECTION 2406.4 (Category class)
9 square feet or less	No requirement	B	A
More than 9 square feet	A	A	A

140

## Glazing Railing Calculation for 4 X Safety Factor

**Note:** Rupture modulus of annealed glass in tension is 6000 psi.

∴ The modulus of rupture of tempered glass is 4 x 6000 or 24,000psi

Formula for calculating a railing with a safety factor of 4 using the diagram @ left.

S = Working Stress

L = Load (200 lbs.)

M = Moment (in. - lbs.)    H = Height (37.875")

Z = Section Modulus

T = thickness of glass in inches

W = Width

### Partial Formula

Requirement for Balustrade assembly = 200 lb. load

$S = \frac{M}{Z}$  (Basic formula)

Z =

S = Modulus of Rapture (mean)

Safety Factor

$S = \frac{24,000}{4} = 6000$  psi (Maximum allowable stress)

4

$M = H \times L$



141

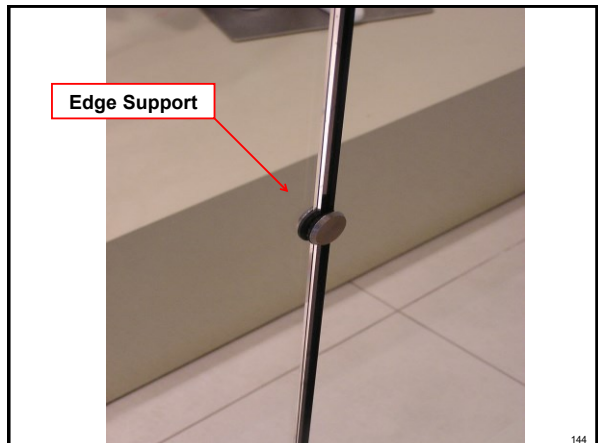


142

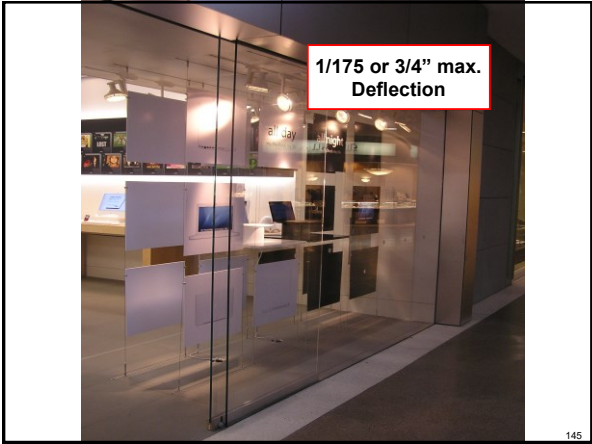
## 2403.2,.3 &.4 Support

- Most glass is supported on all four sides.
- To be considered firmly supported the deflection of the edge of the glass perpendicular to the panel shall not exceed 1/175 of the glass edge length or 3/4 inch, whichever is less.
- When glazing is installed adjacent to a walking surface, the differential deflection of two unsupported edges shall not be greater than the thickness of the panel. (50#/lin.ft. applied horizontally at 42" aff.)

143



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## 2406.3 Hazardous Locations

- Glazing in swinging doors.
- Fixed and operable panels of sliding door assemblies.
- Storm doors.

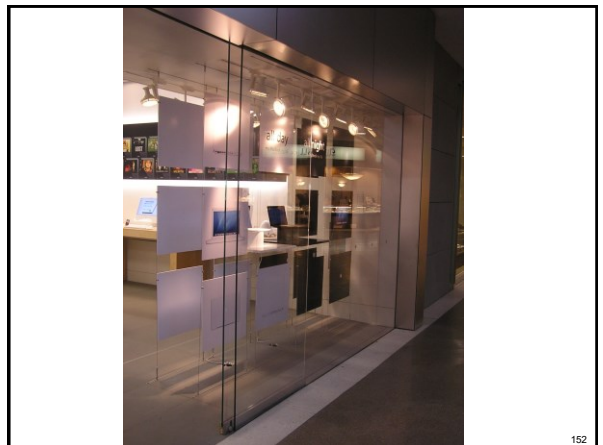
149



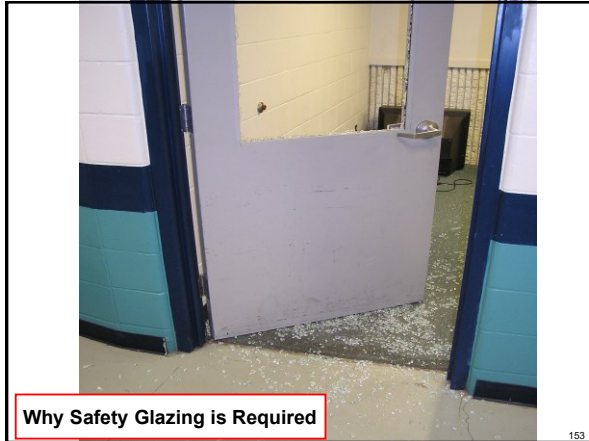
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151



152



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## Glass in Handrails & Guards

- Glass used as a handrail assembly or a guard section shall be constructed of either:
  - single fully tempered glass,
  - laminated fully tempered glass **or**
  - laminated heat-strengthened glass.
- Glazing in railing in-fill panels shall be of an approved safety glazing material that conforms to the provisions of Section 2406.1.1. **(Category II Impact Test)**
- For all glazing types, the min. nominal thickness shall be  $\frac{1}{4}$ ".
- Fully tempered glass **and** laminated glass shall comply with Category II of CPSC 16 CFR 1201 **or** Class A of ANSI Z97.1, listed in Chapter 35.

IBC 2407.1

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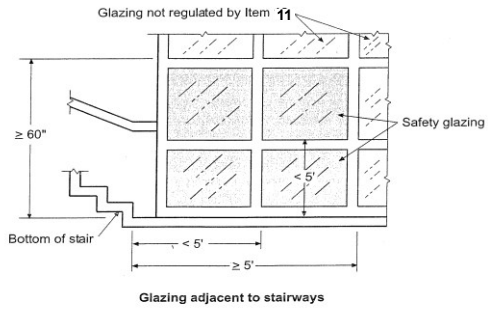
## 2406.4 Hazardous Locations

- Glazing in swinging doors.
- Fixed and operable panels of sliding door assemblies.
- Storm doors.
- Fixed or operable panels within 24" arc of vertical edge of door in a closed position.
- Enclosures for hot tubs, whirlpools, spas, steam rooms, bathtubs and showers.
- Fixed or operable panel >9 sq. ft.; bottom edge <18" above floor; top edge >36" above floor; and walking surface within 36" horizontally of the plane of the glazing.
- Glazing in guards and railings.
- **Glazing adjacent to stairways, landings and ramps.**

R308.4 &amp; IBC 2406

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## 2406.4 Hazardous Locations Item 11



R308.4 &amp; IBC 2406

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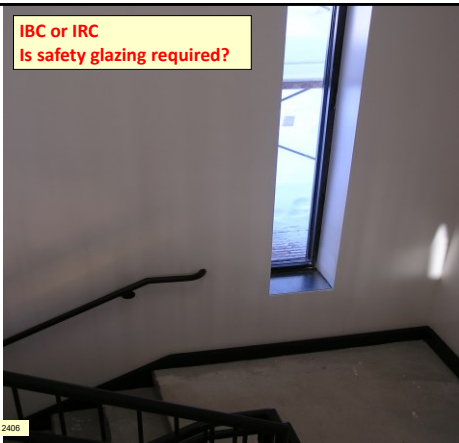
IBC or IRC  
Is safety glazing required?



R308.4 &amp; IBC 2406

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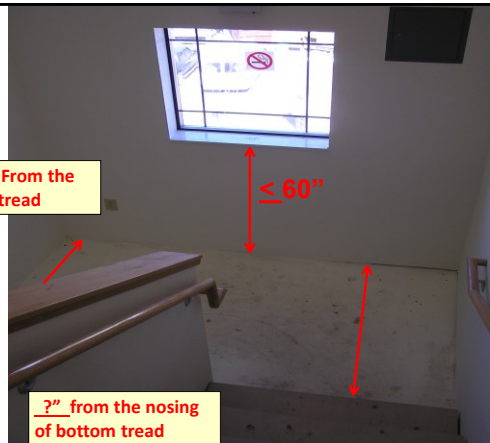
IBC or IRC  
Is safety glazing required?



R308.4 &amp; IBC 2406

159

? " From the  
top tread



? " from the nosing  
of bottom tread

160



161

## Safety Glazing Materials

Glass used as a handrail assembly or a guard section shall be constructed of either single fully tempered glass, laminated fully tempered glass or laminated heat-strengthened glass. Glazing in railing in-fill panels shall be of an approved safety glazing material that conforms to the provisions of Section 2406.1.1. For all glazing types, the minimum nominal thickness shall be  $\frac{3}{4}$ ". Fully tempered glass and laminated glass shall comply with Category II of CPSC 16 CFR 1201, listed in Chapter 35.

**Loads:** The panels and their support system shall be designed to withstand the loads specified in Section 1607.7. A safety factor of four shall be used.

**Support:** Each handrail or guard section shall be supported by a minimum of three glass balusters or shall be otherwise supported to remain in place should one baluster panel fail. Glass balusters shall not be installed without an attached handrail or guard.

IBC 2407 Glass in Handrails and Guards

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What Code Section Applies

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## Racquetball and Squash

Glazing in athletic facilities and similar uses subject to impact loads, which forms whole or partial wall sections or which is used as a door or part of a door, shall comply with this section.

### 2408.2 Racquetball and squash courts.

2408.2.1 Test methods and loads for individual glazed areas in racquetball and squash courts subject to impact loads shall conform to those of CPSC 16 CFR, Part 1201, listed in Chapter 35, with impacts being applied at a height of 59 inches above the playing surface to an actual or simulated glass wall installation with fixtures, fittings and methods of assembly identical to those used in practice.

#### Glass walls shall comply with the following conditions:

1. A glass wall in a racquetball or squash court, or similar use subject to impact loads, shall remain intact following a test impact.
2. The deflection of such walls shall not be greater than  $1\frac{1}{2}$ " at the point of impact for a drop height of 48".

#### Glass doors shall comply with the following conditions:

1. Glass doors shall remain intact following a test impact at the prescribed height in the center of the door.
2. The relative deflection between the edge of a glass door and the adjacent wall shall not exceed the thickness of the wall plus  $\frac{1}{2}$ " for a drop height of 48".

IBC 2408.1

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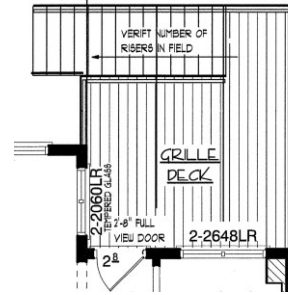


Practice Exercise  
Glazing Review



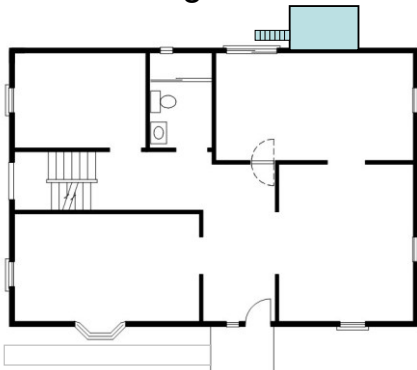
169

Practice Exercise  
Glazing Review



170

Practice Exercise  
Glazing Review

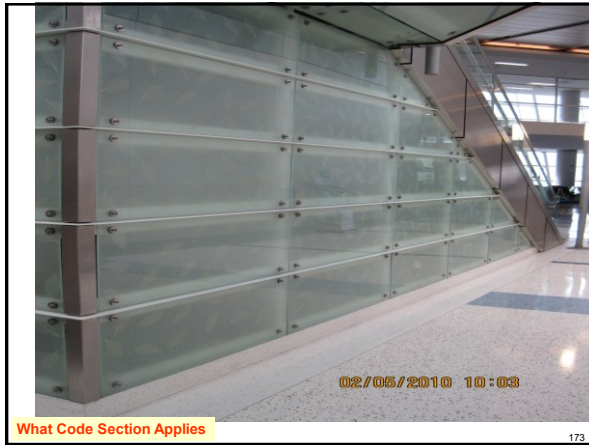


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Safety Glazing – What's required and what's not?

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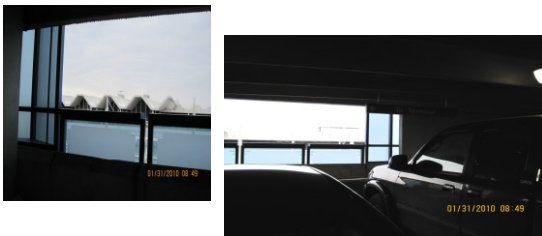


What Code Section Applies

173

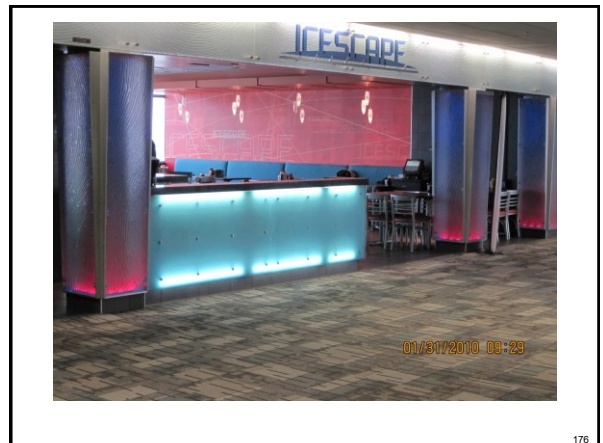


174

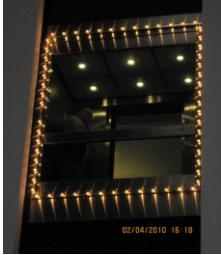


2407.1.3 Parking garages.  
Glazing materials shall not be installed in handrails or guards in parking garages except for pedestrian areas not exposed to impact from vehicles.

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2409.1 Glass in elevator enclosures. Glass in elevator enclosures shall be laminated glass conforming to ANSI Z97.1 or 16 CFR Part 1201. Markings as specified in the applicable standard shall be on each separate piece of glass and shall remain visible after installation.



## Safety Glazing



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## Ancora imparo (I'm still learning)

Michelangelo, 1562, age 87



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## Summary

- Verify all code requirements.
- Amendments must be considered when using the code.
- Beware of manufacturer's requirements
- Call your local building department with questions.
- ...And remember: "Life is good." (Brent Snyder 2006)



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